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MADROÑO

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GEOGRAPHIC RANGE AND INTRASPECIFIC VARIATION OF COULTER PINE

Bruce Zobel

In conjunction with a recent study of the natural hybrid between Coulter and Jeffrey pines, an analysis was made of the characters of several trees in each of nine populations throughout the range of Coulter pine *(Pinus Coulteri* Lamb.). These populations were chosen to include different geographical areas and elevational zones; it was found that they were isolated from each other, especially in the northern portion of the species range. The locations and elevations of the populations are listed in Table 1.

Coulter pine is generally regarded as a species endemic to California. It is found from Mount Diablo and Nortonville (Contra Costa County) in the north to a point in the vicinity of the Mexican border in the south. Some authors, Sudworth (1908) and Martinez (1945), state that Coulter pine is also found in the Sierra de San Pedro Martir, a mountain range in the northern part of Baja California, Mexico, but this has not been substantiated by other investigators (Wiggins, 1940, Duffield, personal communication).

Throughout its range Coulter pine usually grows on the drier, warmer and rockier sites, but it may sometimes be found on the moister, cooler and more fertile ones. It is quite versatile in its ecological requirements and in the number and kind of plant associations in which it is found. Coulter pine grows intermixed with various oak species (except at the Idria locality) and is found associated with Jeffrey pine in all areas studied with the exception of the three northernmost populations of Mount Diablo, Mount Hamilton, and Fremont's Peak (Zobel, 1952). In addition, it is associated with ponderosa pine, sugar pine, coast redwood, Santa Lucia fir, incense cedar and white fir in various combinations at the other areas studied. For example, in the Northern Santa Lucia Mountains all species listed but white fir and incense cedar are found while to the south, at Black Mountain, coast redwood and Santa Lucia fir are replaced by incense cedar and white fir.

Despite the varied ecological and geographical conditions which prevailed in the nine isolated populations, a remarkable similarity was found for most of the characters studied. Although these were chosen primarily for their suitability in analyzing the Coulter-Jeffrey hybrid, they also included those characters most important in determining variation within the two parental species. Characters studied can be broadly grouped into four classes which include those of cone, foliage, oleoresins (volatiles only), and seed.

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TABLE 1. AREAS WHERE COULTER PINE WAS STUDIED IN CALIFORNIA

Key to Localities	Area	County	Mean annual diam. growth inches	Elevation feet
DC	Mount Diablo** (Mitchell Canyon)	Contra Costa	.28	500
MH	Mount Hamilton (Isabel Valley Ranch)	Santa Clara	.26	4,000
FP	Fremont's Peak** (Fremont's Peak State Park)	San Benito	.40	3,000
CR	Chew's Ridge* (Los Padres National Forest)	Monterey	.55	5,000
I	Idria** (Clear Creek)	San Benito	.18	3,500
AM	Alvin Meadow* (San Bernardino National Forest)	Riverside	.38	5,000
BM	Black Mountain (San Bernardino National Forest)	Riverside	.30	7,000
LM	Laguna Mountain (Cleveland National Forest)	San Diego	.37	6,000
BR	Benton's Ranch (Corta Madera Valley)	San Diego	.27	4,200

From four to fifteen trees were sampled at each area.
*Trees well-formed.
**Trees with poor form.

Three cone characteristics were analyzed. Specific gravity of the cones was simply determined and found to be very constant in all 9 areas, the weighted average being 0.93. This means that the cones barely float in water. Cone size was also studied, but proved to be rather variable, absolute lengths and widths varying greatly from site to site (length varied from approximately 10 cm. to over 30 cm., while variation in width was equally large). The ratio of length to width was found to be relatively constant, the average being 1.6 (range 1.4 to 1.7). The third cone character used was qualitative and consisted of a study of several morphological features such as the position and form of the umbo and apophysis, and color of the cone. Disregarding size differences, all these cone characters were

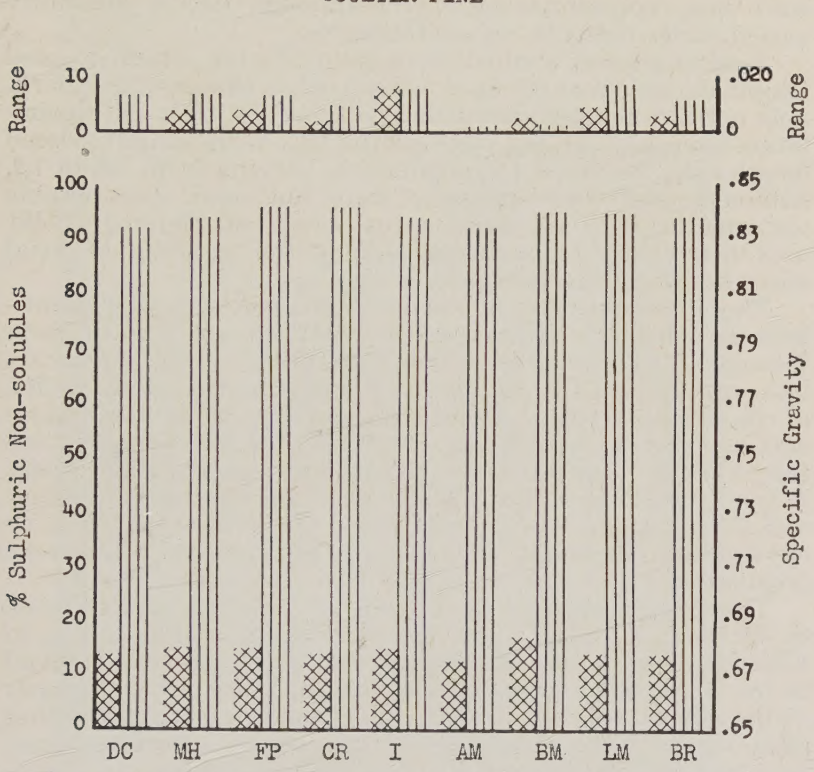

FIG. 1. Graph showing the percent sulphuric acid non-solubles and specific gravities of the steam volatiles of the oleoresins from trees in the nine Coulter pine populations (see Table 1 for key to localities). The cross-hatched area represents the surphuric acid non-solubles and the area of vertical lines represents specific gravities. Note the uniformity among the populations. Range indicates range of variation within populations.

relatively constant throughout the range, with the exception of the Idria locality, as noted later.

Six characteristics of foliage were studied, only one of which was quantitative. These were all originally chosen for their sharp contrast to Jeffrey pine. Anatomically, it was found that a cross section through the needle showed a V-shaped stomata and endodermis with thin walls in all populations studied. Surface stomata shape was rectangular with no wax connections. Number of lines of stomata on the ventral surface varied considerably from tree to tree within each population, but population averages varied from 12 to 16 rows, average slightly over 13. Also evaluated was needle flexibility and the four bud characters of color (brown), presence of resin droplets, non-reflexed scales, and sharp point. The bud characters

were very constant everywhere, although needle flexibility varied somewhat with vigor of tree.

Seed characters studied were ratio of wing length to seed length and seed coat thickness. Seed coat thickness was remarkably uniform in all populations averaging .032 inch, with population averages varying only .028 to .035. Wing length to seed length ratio averaged 1.7, populations varying from 1.4 to 1.9. Although seed color and size were not used, considerable variation between populations was noted, and Fielding (1949) uses these characters as an indication of the beginning of racial variation within certain populations.

The volatile portion of the oleoresins was analysed quantitatively. All characters but optical rotation were very uniform throughout Coulter pine's range. Variability in optical rotation was not unexpected. It averaged —18 degrees, while index of refraction average 1.471, specific gravity .839 and sulphuric acid non-solubles was 21 per cent. Two of these characters are shown in fig. 1 and illustrate the constancy among populations. A brief statistical analysis of oleoresin and cone specific gravities showed that the samples from the nine areas were so similar that they might all have been obtained from the same population.

The general concept of the role of isolation as expressed by Dobzhansky (1941) and Stebbins (1950) would lead us to believe that a number of geographic races should have evolved in the widely separated Coulter pine populations. On the basis of the characters used in this study, however, it appears that such definite local races have not yet evolved, a fact that may be explained partially by the relatively short time, in a geological sense, that these nine populations have been isolated from one another. Undoubtedly fire and man's activities have determined in part the present isolated pattern of distribution of Coulter pine. Sudworth (1908), in discussing the presence of this pine on Fremont's Peak (San Benito County), mentions that it was formerly found over the whole summit of the Gabilan Range. At the present time the population is restricted to Fremont's Peak proper and a few other high areas, with no indication that it has been part of a more extensive stand. When the period of time necessary for one generation of trees to mature and reproduce is taken into account, it is highly improbable that by now the Fremont population would show any effects of isolation.

There is, however, a tendency towards the initiation of distinct geographic races in some populations. This tendency is especially pronounced in the notably different population found near Idria, San Benito County where cones are much smaller than the average, and the shape and size of the umbo and apophysis are extremely variable. On some trees the cones have short, hooked spines while others have long-attenuate,

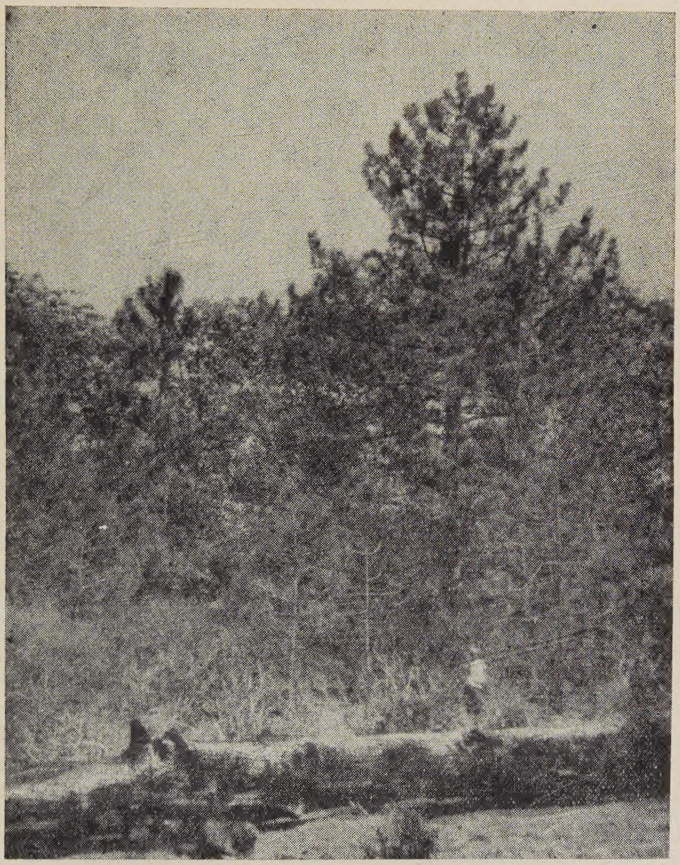

FIG. 2. The common limby form of Coulter Pine, often considered to be the only form the tree attains. Compare with fig. 3.

hooked or even straight spines. Most likely the Idria population represents an edaphic-climatic ecotype in the formative stage, since this is a region where very hot summers, low annual rainfall and poor serpentine, sandy and alkaline soils prevail.

Lemmon (1902) proposed that the Coulter pines in Mitchell Canyon on Mount Diablo be designated *P. Coulteri* var. *Diabloensis* on the basis of their being smaller trees and having shorter leaves, smaller cones, and larger seeds than the type. Cones from the Mitchell Canyon area collected during the course of this study, however, proved to be slightly longer than the average for all nine populations, needle length was average, and seed size was identical with that of seed from Chew's Ridge and Fremont's Peak. Seed weight, as reported by Fielding (1949) was also average. Fielding also stated that cone

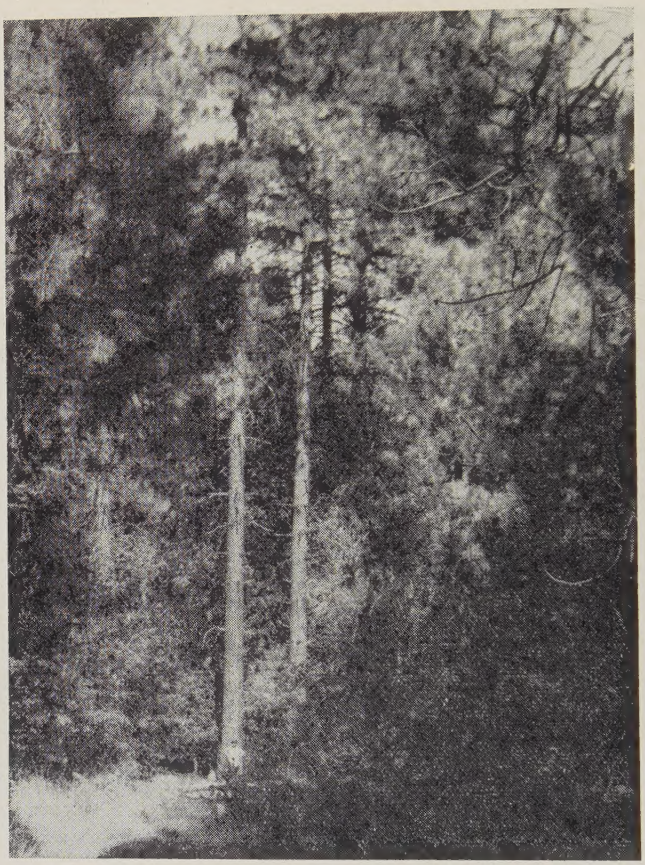

FIG. 3. The large tree on the right shows the fine form that Coulter pine sometimes attains. This tree is growing on a good site in mixture with Jeffrey pine at Alvin Meadow. Less than a mile distant is a pure stand of Coulter pine with a form similar to the trees shown in fig. 2 (see Table 1 for key to areas).

length of the Mount Diablo trees exceeded that in the other localities studied. Therefore, in the writer's opinion, most characters of the Mount Diablo (Mitchell Canyon) Coulter pine fall within the normal range of variation, and subspecific status is not warranted. The writer agrees with Lemmon that the trees in this area are more branched and have poorer form than those of many other Coulter pine populations.

Coulter pines do not all have the same general form (i.e., numerous long, coarse, sweeping limbs that nearly touch the ground) even though their cones, oleoresins, foliage, and seeds are similar (fig. 2). Occasionally, stands of small area were found, usually on more favorable sites, where the Coulter pines

were tall, straight and small-limbed (fig. 3). Whether these well-formed trees are merely the result of similar genotypes selected by superior habitats, or whether they are the result of past introgression of genes of the well-formed Jeffrey pine into Coulter pine, must await suitable genetic tests. Regardless of cause, Coulter pine frequently has the form of a good timber tree which should interest foresters when considered along with its rapid growth rate. In the regions studied, the best-formed trees were found at Chew's Ridge in Monterey County and at Alvin Meadow in Riverside County, while the poorer formed trees were found on Mount Diablo in Contra Costa County, and Fremont's Peak and Idria in San Benito County. However, the populations having the faster diameter growth do not necessarily have the better tree form (Table 1).

Based on the apparent ease of reproduction and the predominance of Coulter pine seedlings over those of its companion species when growing in mixed stands, Coulter pine would appear to be a potentially expanding species. Barring repeated fire on chaparral covered slopes, young Coulter pines become established and dominate an area in a short time if left undisturbed.

Coulter pine has an unfortunate reputation in the literature as a scrubby, inferior, much branched and generally undesirable tree. This is a result of its ability to grow on extremely poor sites where it has poor form and is conspicuous because no other conifers are found growing with it. However, on favorable sites it frequently makes a fine tree. Genetic studies to determine the best genotypes should enable Coulter pine to be included as a regular member of our "wood producing" conifers, either as the species or as a hybrid with some related species such as Jeffrey pine.

Texas Forest Service
College Station, Texas

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STUDIES IN WESTERN VIOLETS. VII.

MILO S. BAKER

Viola purpurea Kell. and its subspecies as well as *V. pedunculata* Torr. & Gray and its subspecies, both members of the *Nuttallianae*, were treated in part six of this series (Madroño 10:110–128. 1949). The present paper completes the account of the *V. purpurea* complex by treating *V. aurea*, another member of the Section *Nuttallianae*, and also proposes new taxa and changes of status in other groups.

VIOLA AUREA

Although closely allied to *V. purpurea*, *V. aurea* is treated herein as a separate species, partly because of its desert habitat and partly because it possesses some characters not found in *V. purpurea*. The flowers of *V. aurea* are somewhat larger, the lateral petals are scantily bearded, and the seeds are more slender than are the nearly spherical seeds of *V. purpurea* and they have a larger caruncle.

VIOLA AUREA Kell. Proc. Calif. Acad. Sci. 2:185. 1862. Erect or decumbent desert plants from a shallow or deep-seated rootstock having a single taproot or a combination of taproot and adventitious roots; stems conspicuous or dwarf during anthesis but more conspicuous later; first leaves long-petioled, more or less rounded and the margins coarsely toothed; cauline leaves many on shorter petioles; herbage mostly grayish owing to pubescence or puberulence (certain races glabrate and therefore of greener aspect); length of peduncles varying from slightly to greatly exceeding the foliage, corolla yellow, purple-backed at least on the upper petals, 15–16 mm. in diameter, lateral petals scantily bearded, spur short, scarcely exserted from the bases of the sepals; sepals linear-lanceolate, pubescent or ciliate, foramen bounded on the lower side by a minute lip, head with many backward-pointing lateral beards; ovary and capsules puberulent; seeds with conspicuous caruncle covering nearly one-third of length of seed, seeds approximately twice as long as wide; chromosomes 12 pairs in two of the three subspecies.

VIOLA AUREA subsp. **aurea**. *V. aurea* Kell. Proc. Calif. Acad. Sci. 2:185. 1862. Illustrations, see Madroño 10: pls. 5, 7, table, p. 117 (as *V. aurea typica*). 1949.

Plants 4–12 cm. tall, geophytic, with winter buds 2–6 cm. below the soil surface; root system of many stout primary and secondary roots supplemented by numerous adventitious roots; stems 1 to 5, one-third to one-half or more subterranean, total length 2–6 cm. above ground erect and crowded with leaves and flowers; plant canescent throughout; basal leaves 1–6, ovate to nearly round, cuneate to almost truncate at base, invariably decurrent on the petiole, conspicuously obtuse at apex, margin

coarsely repand-dentate, 1.4–3.4 cm. wide, 1.2–5 cm. long; cauline leaves more numerous, narrower and sharper at apex, base more often truncate, margins less deeply dentate, ovate to ovate-lanceolate 0.9–1.9 cm. wide and 1.5–3.7 cm. long on petioles 1.4–5.3 cm.; stipules of radical leaves scarious, adnate, forming linear-lanceolate, petiolar wings, the free portion 2–4 mm. long; cauline stipules scarcely foliaceous, ovate-lanceolate to oblong-lanceolate, entire, 5–12 mm. long; peduncles cauline, villous, those of petaliferous flowers mostly as high as or slightly exceeding the foliage, 3–10 cm. long; bracteoles scarious, narrowly linear, ca. 2 mm. long; sepals lanceolate, acute, more or less long-villous and regularly but minutely ciliolate, ca. 1.5 mm. wide and 4–5 mm. long; petals oblong-obovate, 5 mm. wide and 8 mm. long; lateral petals faintly marked by three dark lines, nearly beardless (4–10 beards), narrowly obovate; lower petal with seven distinct lines and two fainter ones, total length including spur 13 mm.; capsule nearly orbicular in outline, ca. 6 mm. in diameter, densely puberulent; seeds brown, average weight 2.15 mg.

Viola aurea was described and named by Dr. Kellogg in 1862 from plants brought to him from "Nevada Territory" by C. W. Dorr. No type specimen was preserved, but there is an illustration (Proc. Calif. Acad. Sci. Ser. 1. 2:187. 1862). There has never been any doubt, however, as to the plant Dr. Kellogg had in mind since, as he states, it is "almost woolly in external appearance."

Until recent years this subspecies was abundant about Verdi and Reno, Nevada, but the plants are fast being exterminated by the grazing and trampling of stock. It ranges from Pyramid Lake, Nevada, south on the east side of the Sierra Nevada to "Mojave Station," the San Bernardino Mountains and to the Cuyamaca Mountains in San Diego County, California, at altitudes from 4000 to 7000 feet. It is far from common; all of the collections in the large herbaria of the United States numbered only seventeen in 1936. Because of the woolly appearance and inconspicuous stems this subspecies is readily distinguished from subsp. *mohavensis* while its woolly pubescence also readily distinguishes it from subsp. *arizonensis*. It belongs in the *V. purpurea* complex because of the thickness and outline of its leaves, its elongated peduncles, its puberulent capsules, and the conspicuously darkened backs of the upper petals.

VIOLA AUREA subsp. **mohavensis** Baker and Clausen subsp. nov. Illustrations, see Madroño 10: pls. 5, 7, pp. 115, 121; table, p. 117, 1949.

A *V. aurea* subsp. *aurea* planta tota propter pilos brevissimos omnino canescente marginibus foliorum radicalium valde sinuatis eis caulinis dentibus incurvatis grosse serratis caulibus magis auctis floribus longipedunculatis discedit.

FIG. 1. *Viola aurea* subsp. *mohavensis* Baker and Clausen, photograph of type specimen.

Erect desert plants, 6–30 cm. high, mostly with gray foliage, covered throughout with a microscopic puberulence or some races glabrate and thus of greener aspect; rootstock erect, deep-seated or near the surface; root system with a long taproot or

several large secondary roots, with or without adventitious roots; stems 1 to 5, 3–10 cm. high during anthesis but occasionally up to 24 cm. in height in fruit; basal leaves several, large, teeth coarse and rounded (op. cit. pl. 5) truncate or slightly cuneate at base, 1–3.5 cm. wide, 1–4 cm. long, on petioles 3.5–11 cm. long; cauline leaves progressively smaller upwards and on shorter petioles, teeth sharper and shaped as in a bandsaw (op. cit. pl. 5); stipules of radical leaves adnate, nearly obsolete, the free wing barely visible, those of the cauline leaves foliaceous, often very unequal even at the same node, variable in shape, lanceolate to linear or oblong, mostly entire, 2.5–5 mm. long; peduncles axillary, extending well above the foliage, bracteoles somewhat scarious, often noticeably separated; flowers as in the *aurea* group, but the amount of bearding on lateral petals variable from about 10 beards to many; seeds light brown, average weight 2.3 mg.

This subspecies is the most "stemmy" and often the tallest in the *V. purpurea* complex; it also has the longest peduncles of the group. It occurs in California from Long Valley, Mono County, and the Coso Mountains of Inyo County, to Mount Pinos and Frazier Mountain and the San Gabriel, San Antonio, San Bernardino, and Cuyamaca mountains. There are two outlying stations: Santa Rita Peak of the San Carlos Range, San Benito County, and Chews Ridge, Monterey County (one collection). In nine collections where the elevations are known, the average elevation is 6300 feet.

Type. Horsethief Canyon in a brushy flat, San Bernardino County, California, elevation 3280 feet, May 3, 1938, *Clokey 5833* (UC; isotypes at most of the large herbaria of the United States; topotype: *Anderson* and *Clokey 6753).*

There are two rather distinct forms of this subspecies, the type representing the more common form. In Mono and Inyo counties is found a form much greener in aspect *(Baker 9090),* lacking the microscopic puberulence (UC and Baker Herb.).

Viola aurea subsp. **arizonensis** subsp. nov. Baker and Clausen. Illustration, see Madroño 10: pl. 5, p. 115, 1949.

A subsp. *aurea* planta tota propter pilos brevissimos ut apud subspeciem *mohavensem* omnino sed minus canescente foliis superioribus plus minusve integris discedit et foliorum marginibus modo subsp. *aurea mohavenseque* intermedio sinuatis.

Regenerating buds rather deep-seated; stems many but undeveloped at time of flowering, later probably conspicuous; basal as well as cauline leaves numerous, grayish-green, covered throughout with a microscopic puberulence similar to that of subsp. *mohavensis;* basal leaves large, on petioles up to 9 cm. long, ovate, somewhat truncate at base but decurrent on the petiole, the margin of earliest basal leaves sinuate as in subsp. *mohavensis,* but the teeth more irregular and shallower,

FIG. 2. *Viola aurea* subsp. *arizonensis* Baker and Clausen, photograph of lower plant on type sheet.

the apex rounded, 2.5–3.3 cm. wide, 2.8–3.5 cm. long; cauline leaves progressively smaller upwards, ovate-lanceolate, long-petioled but shorter than in the basal leaves, the margin upward gradually changing to irregularly undulate, often entire; stipules small, oblong-lanceolate, occasionally toothed, probably becoming more conspicuous in the later growth, scarcely 1 cm. long; peduncles axillary, the earliest somewhat above the leaves, bracteolate above the middle, 8–9 cm. long; sepals narrower and more acute than in the other subspecies, microscopically puberulent and more or less ciliate; corolla similar in size, form and coloring to that of subsp. *mohavensis;* pistil and stamen-sheath much as in the other subspecies; capsules and seeds unknown.

Type. Parker Creek Station, Sierra Ancha Mountains, Gila County, Arizona, April 14, 1939, *Crooks, Darrow* and *Arnold* (UA).

This subspecies is close to subsp. *mohavensis* in the size and outline of the earliest leaves and the size of the flowers. In addition, the pubescence of the young leaves is similar to that of subsp. *mohavensis,* but the old leaves become glabrate.

Subspecies *arizonensis* also differs from subsp. *mohavensis* in the much shorter peduncles, reduced caulescence, and in the narrower and longer sepals as well as in the changed margin of the cauline leaves, where the dentation is much reduced, many of the leaves being entire or nearly so, with none of the band-saw effect which invariably characterizes subsp. *mohavensis.*

The description of this subspecies is scanty owing to a lack of material, there being but two known collections. The only collection besides that of the type was made by Mrs. Rose Collum (Mazatzal Mountains, Gila County, Arizona, April 8, 1933 at 6000 feet elevation, US, NY).

Viola californica

Viola californica sp. nov. Gregi erecto-nudicaulibus affinis ex rhizomate tenui elongatoque omnino sparce puberulenta caulibus petiolis ac pedunculis hirsutis foliis tenuibus utrinsecus plus minusve ejusdem coloris profunde crenato-serratis numquam crasse irregulariterque dentatis eis superioribus saepe profunde cordatis elongatis apice lanceolatis sed apicem versus ut apud *V. lobatam* var. *integrifoliam* haud angustatis corolla lutea magna petalis superioribus parte posteriore tantum leviter fuscatis sepalis ciliatis insigniter longis angustique stylo basi subito sursum flexo.

Rootstock long and slender, stems 1 to 4, erect, 5-20 cm. high, naked below except for a scarious bract towards the base; herbage sparingly puberulent, basal leaves 1 or 2, but occasionally 3 or 4, cauline leaves 2 to 5 near the summit of stem; rootstock erect or ascending, usually long and slender, functional roots mainly adventitious, the taproot of the seedling disappearing early; leaves thin, about the same shade of green on both surfaces, margin crenate-serrate, on plainly hirsutulous petioles; basal leaves ovate-cordate, with deep sulcus and a short acuminate tip, width and length (3–6 cm.) approximately equal, on petioles 6–14 cm. long; lower cauline leaves as large as basal leaves but more elongated with little if any narrowing at base of the enlarged acuminate tip; the base of the cauline leaves may be as deeply cordate as the basal leaves or subcordate, but rarely, if ever, truncate; stipules narrowly lanceolate, scarcely foliaceous, entire, less than 1 cm. in length; stems stout, clearly hirsutulous above; peduncles with the same pubescence as the stems, 3–10 cm. long, equalling leaves; bracteoles inconspicuous, borne near the middle of peduncle; flowers few but large, the diameter in fresh specimens up to 2.6 cm.; petals broad, yellow, the upper faintly purple-backed, the lateral scantily clavate-bearded; sepals ciliate, gland-tipped, long and narrow, the lowermost narrowly linear-lanceolate, scarcely 2 mm. wide at base, 10 mm. long, the upper ones hardly enlarged at base, up to 13 mm. long; style, as in *Viola glabella*, with a sharp upward flexure at the ovary and a barely discernible stigmatic tube surrounding the foramen (fresh flowers); capsule elliptical, glabrous, beaked, similar to that of *V. glabella* but somewhat larger; mature seeds unknown.

Type. Coniferous forest, mainly *Abies concolor*, South Fork Mountain, Humboldt County, California, 5000 feet, June 14, 1946, *Baker 11492* (UC 707010); isotypes: DS, POM, MO, US, GH, NY, F, CAS, WTU, PH, WILLU, OSC.

FIG. 3. *Viola californica* Baker.

The only collections known to me of *Viola californica*, aside from the type, are as follows: CALIFORNIA. Humboldt County: South Fork Mountain, 1926, *Baker 89* (UC); Grouse

FIG. 4. *Viola lobata* Benth. var. *integrifolia* Wats. From a plant growing near Ingot, Shasta County, California.

Mountain, *J. P. Tracy 12907, 14068, 15912½, 15917* (UC); near Box Camp, 5000 feet, *Baker 11900, 11905* (Baker Herbarium). Trinity County: Happy Camp Mountain, Trinity Summit Range northeast of Hawkins Bar, 4200 feet, *Tracy 11655* (UC).

This is a rarely collected species. It first came to my attention late in July of 1926 when I discovered it in the coniferous forest of South Fork Mountain. Unquestionably it seemed to belong with the *Erectae Nudicaules* group (Section Chamaemelanium), represented on the Pacific Coast by *Viola glabella* Nutt. and *V. lobata* var. *integrifolia* Wats. Being entirely out of flower, it seemed at the time of discovery nearer to the former because of its foliage. However, the hirsutulous petioles, stems and peduncles, and elongated upper leaves left doubt as to the identity of this violet. So it remained an enigma until I learned that Mr. Joseph Tracy of Eureka, California, had been collecting the same strange violet not only on South Fork Mountain, but also at several other places in Humboldt County, all having an elevation of 5000 feet or higher.

In June, 1946, I again collected this violet on South Fork Mountain, this time in good flower. Although intermediate between *V. glabella* and *V. lobata* var. *integrifolia* Watson, it possesses some characters which are not found in either of those taxa.

From *V. glabella* it differs in having larger flowers, plainly hirsutulous stems, peduncles and petioles, in its ciliate and more slender sepals, and in its elongated upper leaves. Its habitat too is distinctive, for it grows on dry, rocky, upland soil. The rootstocks are usually more slender and much longer than in *V. glabella.*

From *V. lobata* var. *integrifolia* it differs in the abundant, much thinner leaves which are concolorous above and below, and which are regularly crenate-serrate rather than irregularly dentate, in the lower cauline leaves which are often as large and as deeply cordate as the radical leaves and in the uppermost cauline leaves which are rarely or never truncate, and not narrowed above the middle as is common in *V. lobata* var. *integrifolia,* in the upper petals which are only slightly darkened on the backs, and in the style which differs in having a sharp upward flexure near the ovary.

In conclusion, because of the large corolla, the narrow and elongated sepals, and the clearly pubescent stems, petioles and peduncles, *V californica* should never be confused with either *V. glabella* or *V. lobata* var. *integrifolia.*

Owing to the fact that *V. lobata* var. *integrifolia* exhibits considerable variation throughout its range from southern Oregon to the southern border of California, it should be made clear that in the foregoing comparison I have in mind those plants of var. *integrifolia* growing in the region of Humboldt County, in proximity with *V. californica.*

Viola californica may have arisen as a hybrid between *V. glabella* and *V. lobata* var. *integrifolia*. It is very abundant in the forest of South Fork Mountain at 5000 feet. Mr. Tracy and I collected this violet for several miles along the forest road on this mountain but could not locate any plants below the lower altitudinal limit of the white fir. Likewise, in northern Humboldt County, Mr. Tracy has found it growing only in fir forests.

In 1949, I expressed the opinion (Leafl. West. Bot. 5:176) that the species under consideration here is *V. deltoidea* Greene. I have recently re-examined my collection of the latter species from the type locality at Waldo, Oregon, and have now come to the conclusion, that Greene's *V. deltoidea* is only a form of *V. lobata* var. *integrifolia* Wats.

Viola pallens and Viola Macloskeyi

In the West we have two white-flowered violets which are difficult to distinguish. The type locality of one, *V. Macloskeyi* Lloyd, is on Mount Hood in northern Oregon, the plant ranging southward through Oregon and California. The other, *V. pallens* (Banks) Brainerd, in its typical form, ranges from northeastern Washington (Diamond Lake, Pend Oreille County, 9 May 1923, *Spiegelhaus*, UC), north into British Columbia, east through Canada to the region of the Great Lakes and on to the higher mountains of the Atlantic States and north into Labrador and Greenland. (Reported collections of *V. pallens* from Colorado, Montana, Wyoming, Utah and Idaho have proved to be either *V. palustris* L., or *V. palustris* subsp. *brevipes* Baker.)

Between the main ranges of these two white-flowered violets, however, is an area where the distinguishing characters appear to intergrade. The following collections do not fall readily into either group. Washington: swamp near Tacoma, *Flett 108, 2222* (WS); cold bog near Olympia, Henderson *2054* (WS); British Columbia: Stanley Park near Vancouver, April and October 1913, *Henry* (Baker Herbarium); near summit of Mount Arrowsmith, *Baker 850* (Baker Herbarium). Oregon: Crater Lake, *Baker 604*, nearer to *V. Macloskeyi* except for leaf margins (Baker Herbarium); near Tumulo Ranger Station, Crook County, altitude 6000 to 7000 feet, *Ferris* and *Duthie 463* (DS), lateral petals with little or no bearding, otherwise like *V. Macloskeyi*.

Inasmuch as these taxa both have twelve pairs of chromosomes and as they appear to intergrade along their common borders, it seems reasonable to regard these two white-flowered violets as belonging to a single species. The appropriate new combinations are herewith proposed.

Viola pallens (Banks ex DC.) Brainerd subsp. **pallens.** *V. rotundifolia* var. *pallens* Banks ex. DC. Prodr. 1:295, 1824. *V. pallens* Brainerd, Rhodora 7:247. 1905.

This subspecies includes the northern and eastern material.

VIOLA PALLENS (Banks ex DC.) Brainerd subsp. **Macloskeyi** (Lloyd) comb. nov. *V. Macloskeyi* Lloyd, Erythea 3:74. 1895. *V. blanda* var. *Macloskeyi* Jepson, Man. Fl. Pl. Calif. 648. 1925.

This subspecies includes all material known at this time from Oregon and California.

VIOLA BECKWITHII

VIOLA BECKWITHII T. & G. subsp. **glabrata** subsp. nov. A subsp. Beckwithio foliis glabris vel glabratis segmentibus foliorum latioribus differt.

Root, rootstock, stems, foliage and flowers as in *V. Beckwithii* subsp. *Beckwithii,* except foliage glabrous or with only a trace of puberulence and leaf segments wider; habitat as far as known, open grassy spots in coniferous forests.

Type. Open grassy spots in coniferous forest along Highway 89, about 5 miles south of junction with Highway 36, altitude 4700 feet, Plumas County, California, *Baker 12435* (UC 954252).

Other collections. California. Lassen County: *H. K. Myers* in 1930 (UC, Baker Herbarium); Fredonyer Pass, altitude 5750 feet, *H. C. Cantelow 4537* (CAS), *Baker 12423* (Baker Herbarium). Nevada County: southeast end of Boca Dam, *Cantelow 4551* (CAS). Sierra County: Sardine Lake, *Sonne* in 1887 (JEPS).

The following characters of the Myers collection originally influenced me in placing the plant with *Viola Hallii:* the glabrous or glabrate foliage; the cream-color of the three lower petals; the width of the leaf-segments which are as coarse or coarser than those of *V. Hallii.*

Recent field work in Mount Lassen National Park and vicinity, Lassen County, has shown that petal-color varies from medium lavender to cream *(Baker 12435),* a color-range also occasionally exhibited in typical *V. Beckwithii.* Leaf-puberulence is also slightly variable, but the leaves are never abundantly puberulent as in *V. Beckwithii.*

This Lassen County material further resembles *V. Beckwithii* in its upper petals which are parallel with each other and at right angles to the plane of the lower petal rather than being approximately in the same plane as the lower petal, as is the case in *V. Hallii.* In the reduced aerial caulescence concomitant with the more deeply seated rootstock, these plants resemble *V. Beckwithii* rather than *V. Hallii.* The latter has a shallowly buried rootstock with a resultantly larger proportion of stem above ground.

Viola Beckwithii subsp. *glabrata* occurs at somewhat higher elevations than the typical form and in several cases at least, in open spots in coniferous forests.

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A MONOGRAPH OF THE GENERA BLOOMERIA AND MUILLA (LILIACEAE)

JOHN INGRAM

This paper treats the two small liliaceous genera, *Bloomeria* and *Muilla*. *Bloomeria* has two species, ranging from San Benito County, California, to northern Baja California, Mexico, while *Muilla* has three ranging from Glenn County, California, to northern Baja California and east to western Nevada. Keys have been included to separate closely related genera as well as the species and varieties of *Bloomeria* and *Muilla*. An exclamation point (!) indicates that the type, isotype or photograph of the type has been examined. Where type specimens have not been seen, species determinations have been based on original descriptions aided by available photographs.

This study is based on herbarium material and on fresh material collected by the author. In the study of herbarium specimens measurements of scapes, leaves, and pedicels were made on dry material, but the floral parts were first boiled in water.

The author wishes to thank the following people: Dr. Louis C. Wheeler for suggestions and supervision; Mr. John Thomas Howell, California Academy of Sciences, for information regarding type material: Dr. Albert L. Delisle, Curator of the Greene-Nieuwland Herbarium, University of Notre Dame, for pertinent information concerning Greene's type species; Mr. John McB. Robertson for aid in collecting specimens; the curators of various herbaria and Mr. Robert L. Dressler for loan of specimens.

In the citation of specimens, herbaria are referred to by the abbreviations listed in Lanjouw and Stafleu (Index Herbariorum, part 1, 1952). Abbreviations for herbaria not included in this list, are: Herbarium of Robert L. Dressler, University of Southern California, Department of Botany (D); Herbarium of the author (IN); The Vegetation Type Map Herbarium of the California Forest and Range Experiment Station, University of California, Berkeley (VTM).

KEY TO BLOOMERIA, MUILLA, AND CLOSELY RELATED GENERA

Pedicels jointed at the summit.
- Perianth-segments united into a distinct tube ..... *Brodiaea*
- Perianth-segments distinct to the base ..... *Bloomeria*

Pedicels not jointed at the summit.
- Plants arising from fibrous-coated corms, herbage not having the odor of onions; perianth-segments 2 or 3 nerved ..... *Muilla*
- Plants arising from tunicated bulbs or corms, herbage having the odor of onions; perianth-segments 1 nerved ..... *Allium*

BLOOMERIA Kell. Proc. Calif. Acad. 2:11. 1859.

Stem scapose, arising from a fibrous-coated corm; leaves, basal, linear, and carinate; flowers numerous, yellow, in a loose

terminal umbel; pedicels subtended by numerous membranous bracts. Perianth-segments 6, distinct, nearly equal, oblong-linear, subrotate at anthesis, persistent. Stamens 6, fertile, a little shorter than and inserted on the base of the perianth-segments; filaments margined at the base by wing-like or cup-shaped appendages; anthers versatile, attached near the base. Style 1, persistent, splitting with the subglobose, loculicidal capsule. Seeds 1 to several per locule, black, subovoid, angular and wrinkled. (H. G. Bloomer, early California botanist and one time Botanical Curator of the California Academy of Sciences, San Francisco.) Type Species: *Bloomeria aurea.*

KEY TO SPECIES AND VARIETIES OF BLOOMERIA

Filament margined by an oblong, entire, smooth appendage (fig. 2, 4); style shorter than the ovary; leaves several. San Diego County ..... 1. *B. Clevelandii.*

Filament with a basal papillose nectariferous cup (appendage); style longer than the ovary; leaf solitary, rarely two.

Nectariferous cup of the filament shallowly bicuspidate at apex (fig. 2, A) ..... 2a. *B. crocea* var. *crocea.*

Nectariferous cup ending in 2 awn-like cusps.

Cusps not attenuate, 1 to 2 mm. long, less than half as long as the filament (fig. 2, B) ..... 2b. *B. crocea* var. *aurea.*

Cusps attenuate, 3 to 3.5 mm. long, about half as long as the filament (fig. 2, C) ..... 2c. *B. crocea* var. *montana.*

1. BLOOMERIA CLEVELANDII S. Wats. Proc. Am. Acad. 20:376. 1885. Type: mesas near San Diego, California in 1884, *Cleveland* (GH!). The type is representative of the species.

Scape 12.5–25.5 cm. long, scabrous; pedicels 2.5–4 cm. long; flowers 10 to 20; perianth-segments 6–10 mm. long, yellow with a green central stripe; filaments 3–5 mm. long; anthers 1.5–2.5 mm. long, pale yellow or white; appendages of the filaments smooth, oblong, entire, obtuse at the apex.

Distribution. *Bloomeria Clevelandii* occurs only in San Diego County, California (fig. 1, B).

Material examined. San Diego County: south side Montezuma Road, south of Alvarado tract, San Diego, *Ingram 102* (IN, LAS); Camp Kearney Mesa, *Purer 6534* (LAS); San Diego, *Cleveland* (UC); San Diego and vicinity, *Woodcock 80* (UC); San Diego, *Greene* in 1885 (UC); San Diego, *Orcutt* in 1884 (UC); Linda Vista on Kearney Mesa, *Gander 8316* (UC); Rancho Santa Fe, *Gander 8308* (UC).

The smooth, oblong stamen appendage of *B. Clevelandii* clearly separates it from *B. crocea* whose filaments have a basal papillose, nectariferous cup (fig. 2). Furthermore, it often has two or three scapes per corm, whereas *B. crocea* has only one.

2. BLOOMERIA CROCEA (Torr.) Cov. Contr. U.S. Nat. Herb. 4:203. 1893.

Scape 20–70 cm. long (average 40), minutely scabrous; leaf solitary, about as long as the scape, 3–15 mm. wide; pedicels

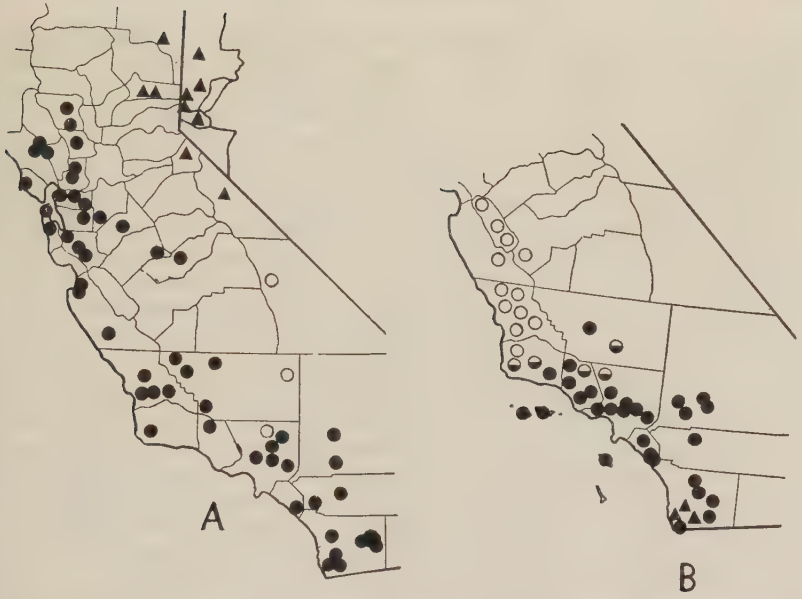

FIG. 1. A. Range of *Muilla* in California and Nevada. *M. maritima*, dots; *M. coronata*, circles; *M. transmontana*, triangles. B. Range of *Bloomeria* in California. *B. crocea* var. *crocea*, dots; *B. crocea* var. *aurea*, circles; *B. crocea* var. *montana*, half-filled circles; *B. Clevelandii*, triangles.

5–65 mm. long (average 30); flowers 5 to 75 (average 30 to 45); perianth-segments 5–13 mm. long (average 8), yellow with a brown mid-vein; filaments 3–10 mm. long; anthers 1.5–3 mm. long; appendages of the filaments papillose; style longer than the ovary.

2a. BLOOMERIA CROCEA (Torr.) Cov. var. **crocea.**

Allium croceum Torr. in Emory, U.S. & Mex. Bound. Surv. 2 (1): 218. 1859[1]. Type: summit of mountains east of San Diego, California, in 1859, *Parry* (NY!). The type is an average specimen except for fewer flowers. *B. crocea* Cov., Contr. U.S. Nat. Herb. 4: 203. 1893.

Perianth-segments yellow-orange, 5–12 mm. long; stamen appendages bicuspidate at the apex.

Distribution. This variety ranges from western Kern County, Santa Barbara County, and the Channel Islands, California, to northern Baja California (fig. 2, B).

Representative specimens examined. CALIFORNIA. Santa Barbara County: Santa Rosa Island, *Youngberg* in 1938 (POM); Pelican Bay, Santa Cruz Island, *Clokey 4829* (UC); Santa

[1]According to I. M. Johnston (Jour. Arn. Arb. 24: 237. 1943) volume two was issued in late April or May, 1859.

Barbara, *Carlson* in 1918 (CAS). Kern County: mesas near Bakersfield, *Osborn* in 1930 (LAM). Ventura County: Sulfur Mountain, *Epling & Anderson* in 1931 (LA); Saticoy, *Eastwood 5059* (CAS); Happy Camp Canyon, Piru quadrangle, *Gifford 109* (VTM). Los Angeles County: Puente Hills near Pomona, *Ingram 104* (IN, LAS); Santa Catalina Island, *K. Brandegee* in 1916 (UC); Mandeville Canyon, *Clokey & Templeton 4543* (UC); Pico Canyon *Johnstone* in 1931 (LAS); near University of California, *Wheeler 672* (LA); Franks Canyon north of Beverly Hills, *Templeton 1069* (LAM). San Bernardino County: Mt. Horne, San Bernardino Mountains, *Lemmon* in 1888 (UC); Mohave River, *Parry & Lemmon 392* (UC); Seven Oaks, *Davidson 2243* (LAM); Mentone, *Lewis* in 1936 (LA). Riverside County: near Highgrove, *Edge* in 1934 (LAS). Orange County: Laguna Beach, *Johnson 4419* (LA); north of Orange, *Johnson 4023* (LA); San Juan Canyon, *Cooper 1343* (LA). San Diego County: Palomar Mountain, *Cooper 1477* (LA); mesas, Mountain Springs Grade, *Orcutt 155* (UC); Black Canyon, Otay Ranch, *Gander 7476* (UC); Rancho Santa Fe, *Gander 8307* (UC) Cuyamaca Lake, *Higgins 3158* (UC); Escondido, *Meyer 742* (UC). Baja California. Aliso, *T. S. Brandegee* in 1893 (UC).

The perianth-segments are nearly always striped by two dark parallel lines. The width and darkness of the lines vary, and they are absent in some flowers. The color of the anthers ranges from green to blue-green and even purple.

2b. Bloomeria crocea var. **aurea** (Kell.) comb. nov.

Bloomeria aurea Kell., Proc. Calif. Acad. 2:11. July, 1859; Hesperian 3:437. December, 1859. Type locality: New Idria, California. Inasmuch as no type specimen is known to exist (J. T. Howell, written communication, 18 January 1951), the interpretation of this species is based on Kellogg's description and the diagram in Hesperian. *Nothoscordum aureum* Hook. f., Bot. Mag. 27: pl. 5896. 1871.

Flowers 5 to 50; perianth-segments yellow, 11–12 mm. long; cusps of the filament appendages linear, 1–1.5 mm. long.

Distribution. This variety occurs in the Coast Ranges from San Benito County to northern Santa Barbara County, California (fig. 1, B).

Material examined. San Benito County: Pacheco Pass, near Camp 77, *Brewer 1291* (CAS, UC); Pinnacles, *Epling 8415* (LA); Pinnacles, *Rodder* in 1926 (CAS). Monterey County: Mustang Grade, *Eastwood & Howell 5807* (CAS). Fresno County: San Lucas Road in Alcalde Canyon, 7.5 miles west of Coalinga, *Ferris & Bacigalupi 10355* (CAS, UC). San Luis Obispo County: Cholame, *Eastwood 13895* (CAS); near Morro, *Barber* in 1899 (UC); Paso Robles, *Dudley* in 1927 (CAS); Freeman Canyon, Paso Robles quadrangle, *Lee 949* (VTM); ¼ mile

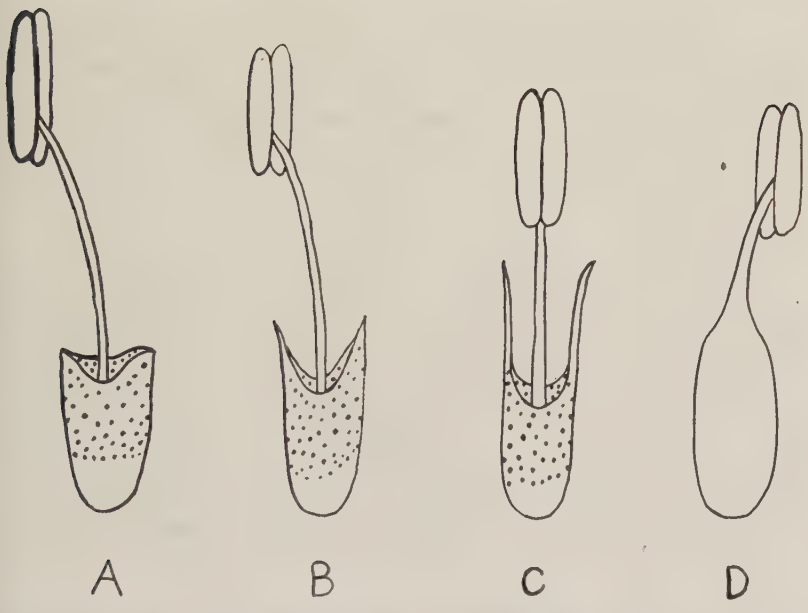

FIG. 2. Diagrams of the stamens of *Bloomeria* (ca. × 5). A, *B. crocea* var. *crocea;* B, *B. crocea* var. *aurea;* C, *B. crocea* var. *montana;* D, *B. Clevelandii.*

south of Canmatti Ranch, Pozo quadrangle, *Hendrix 219* (VTM). Santa Barbara County: Suey Creek, near Santa Maria, *Eastwood 385* (CAS).

Variety *aurea* differs from variety *crocea* in its filament appendages. A drawing in Hesperian on p. 438 clarifies what Kellogg described as appendages resembling "awned achenia of many composites" in var. *aurea*. Torrey described the filaments of *B. crocea* var. *crocea* as "filiform, with an oblong, adnate tooth on each side of the base." Diagrams of the stamens (fig. 2) showing the relationships between the varieties of *B. crocea* clarify the statements of Kellogg and Torrey.

2c. BLOOMERIA CROCEA var. **montana** (Greene) comb. nov. *Bloomeria montana* Greene, Bull. Calif. Acad. 1:281. 1885. Type: mountains of Kern County, California, near Tehachapi in 1884, *Curran* (CAS 127!; isotype, UC!). The type is representative of the species.

Perianth-segments yellow, 11–13 mm. long; cusps of the filament appendages 3–3.5 mm. long, attenuate, about half as long as the filaments.

Distribution. This variety is found in the Tehachapi Mountains and in the southern Coast Ranges, California (fig. 1, B).

Material examined. Kern County: north of Tehachapi, *Ingram & Dressler 913* (IN, D); near Tehachapi, *Davidson 1904* (LAM). Santa Barbara County: head of Santa Agueda Creek, Lompoc quadrangle, *Axelrod 494* (VTM); trail to Manzana Creek, Zaca Lake Forest Reserve, *Eastwood 616* (CAS). Ventura County: Mt. Pinos, *Hart 21* (CAS); Lockwood Valley, Mt. Pinos, *Hall 6443* (CAS). Los Angeles County: Ridge Route, *Winblad* in 1937 (CAS).

MUILLA S. Wats. Proc. Am. Acad. 14:235. 1879.

Stem scapose, arising from a fibrous-coated corm; leaves basal, usually few, subterete to terete. Flowers several, white or greenish-white, in an umbel subtended by several scarious bracts. Pedicels not jointed at the summit, subtended by several membranous bracteoles. Perianth of 6 parts, subrotate at anthesis, distinct almost to the base with a dark 2 or 3-nerved midvein. Stamens 6, fertile, inserted at the base of the perianth-segments; filaments filiform or petaloid; anthers versatile. Style clavate, persistent, and at length splitting with the globose, slightly lobed, loculicidal capsule. Seeds 1 to several per locule, compressed, angled and black. (Anagram of *Allium.)* Type species: *Muilla maritima.*

KEY TO SPECIES OF MUILLA

Filaments petaloid.....1. *M. coronata.*
Filaments not petaloid; filiform above, dilated, free or united at the base.
Flowers white, filaments dilated, united basally to form a shallow cup around the ovary.....2. *M. transmontana.*
Flowers greenish-white, filaments dilated, not united basally
3. *M. maritima.*

1. MUILLA CORONATA Greene, Pittonia 1:165. 1888. Type: Lancaster, Mohave Desert, California, late in March, 1888. *Parry* (ND not seen; photograph IN!, LAS!). The interpretation of the species is based on the description and the photograph of the specimen labeled "*M. coronata* Greene, Pitt. 1:165" (in Greene's hand fide Dr. Albert Delisle). The label reads "April" instead of "late in March," but this specimen is presumably the type as it is the only Parry collection of this species in the Herbarium Greeneanum.

Scape 8.5–15 cm. long; leaves 2 or 3, subterete, about twice as long as the scape; pedicels 3 to 8, 5–14 mm. long; perianth greenish-white with very wide, green midveins; filaments petaloid, their margins overlapping but not joined, retuse at the summit; anthers yellow, attached by the middle at the notch.

Distribution. *Muilla coronata* is found only on the Mohave Desert, California (fig. 1, A), and is not common.

Material examined. Inyo County: 1 mile west of Independence, *Kern 488* (CAS). Kern County: Iron Canyon, El Paso Mt., north rim of Mohave Desert, *Weston* in 1926 (CAS). "Mohave Desert," *Sherwood* in 1932 (LAS).

This species is easily distinguished by its unique petaloid filaments.

2. MUILLA TRANSMONTANA Greene, Pittonia 1:73. 1887. Type: Reno, Nevada, *Amy Pease.* [This specimen has not been located.] The interpretation of the species has been based on geographic location, the description by Greene, and on a photograph of a specimen labeled "*M. transmontana,* Pittonia 1:73" in Greene's hand. This specimen was collected at Reno, Nevada, May 1888, by C. F. Sonne and is located in the Herbarium Greeneanum at the University of Notre Dame. In a letter of April 22, 1951, Dr. Albert Delisle states that the handwriting on this specimen is Greene's.

Scape 10.5–50 cm. long (average 21), usually fusiform-enlarged at the ground; leaves 3 to 5, as long or longer than the scape; pedicels 10 to 25 (average 15), 2 cm. long; perianth-segments white, 6–8 mm. long, 2 mm. wide, 2-nerved; filaments ca. 3 mm. long, widely dilated at the base, united at their bases forming a cup around the ovary; anthers 1.5–2 mm. long, yellow.

Distribution. This species is found in western Nevada and in the adjoining counties of California (fig. 1, A).

Material examined. CALIFORNIA. Lassen County: south of Janesville, *Ripley & Barneby 5953* (CAS). Alpine County: Hope Valley, *Eastwood & Howell 8477* (CAS, POM). Sierra County: about 3½ miles east of Loyalton, *Stebbins & Jenkins 2131* (UC). Mono County: Twin Lake Road, 11:5 miles west of Bridgeport, *Cantelow* in 1941 (CAS). NEVADA. Ormsby County: King's Canyon, *C. F. Baker 933* (POM); Carson City, *M. E. Jones* in 1897 (POM). Washoe County: 8 miles north of Reno along road to Pyramid Lake, *Mathias 1218* (UC) 7 miles northwest of Poeville, *Tillotson 83* (VTM); Verdi, *Sonne* in 1889 (UC).

Muilla transmontana differs from *M. maritima* in having filaments which are much wider, and basally united to form a shallow basal cup around the ovary. The perianth-segments are not quite distinct to the base, but form a short tube. The fusiform enlargement of the scape is not evident in all of the dry specimens.

3. MUILLA MARITIMA (Torr.) S. Wats., Proc. Am. Acad. 14:235. 1879.

Hesperoscordium? maritimum Torr. in Whipple, Rep. Expl. & Surv. Miss R. to Pacific Ocean 4 (5):148. 1857[2]. Type: seashore, Punta de los Reyes, California, *Bigelow* (NY!). This is an average specimen. *Allium maritimum* Benth., Pl. Hartw. 339. 1857. *Milla maritima* S. Wats. in King, U.S. Geol. Expl. 40th Par. 5:354. 1871. *Bloomeria maritima* Macbride, Contr. Gray Herb. ser. 2, 56:8. 1918.

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[2]Date according to I. M. Johnston (Jour. Arn. Arb. 24:242. 1943).

Muilla serotina Greene, Erythea 1:152. 1893. Type: near Los Angeles, California, *Davidson 2052* (UC 119707!). *Bloomeria maritima* var. *serotina* Macbride, Contr. Gray Herb. ser. 2, 56:8. 1918.

Muilla tenuis Congdon, Zoe 5:35. 1901. Type: Raymond, Madera County, California, *Congdon* in 1900 (UC 119714!).

Scape 8–38 cm. long; leaves 3 to 10, almost terete, retrorsely scabrous, shorter or longer than the scape; pedicels 1.5–5 cm. long, unequal; flowers 5 to 35 per umbel; perianth-segments 3–5 mm. long, 1.5–2.5 mm. wide; filaments filiform, 1.5–2.5 mm. long, their bases dilated, not united; anthers 1–2 mm. long.

Distribution. *Muilla maritima* occurs in the mountains and lowlands from Glenn County, California, southward to northern Baja California (fig. 1, A).

Material examined: California. Glenn County: 4 miles south of Willows, *Heller 15363* (UC); Norman, *Hoover 3234* (UC). Colusa County: about 20 miles north of Williams, *Meyer 1346* (UC). Lake County: near Calistoga Geyser, *Baker 3565b* (UC). Napa County: Myrtledale Hot Springs near Calistoga, *Howell 1760* (CAS); Geysers south of Calistoga, *Keck 1096* (POM). Sonoma County: opposite Myrtledale Geyser, 1½ miles north of Calistoga, *Bacigalupi 1252* (POM). Marin County: Pt. Reyes Peninsula, *Howell 21756* (CAS). Solano County: Little Oak Ranch, *Jepson* in 1885 (UC). Contra Costa County: Stege, *Davy 6527* (UC); Byron Springs, *Eastwood 3788* (CAS). San Joaquin County: Castle Rock, Corral Hollow, *Constance & Beetle 2526* (CAS, POM, UC). Alameda County: Livermore Valley, *Howell 13740* (CAS). San Francisco County: Twin Peaks, *Hoover 2813* (UC); San Francisco, *Greene* in 1888 (UC). San Mateo County: Crystal Springs Lake, *Baker 423* (POM, UC). Santa Clara County: 4 miles east of Monument Peak, *Wilson 569* (UC); San Martin, *Chandler 863* (UC). Stanislaus County: Carpenter Road near San Joaquin River, *Hoover 4331* (UC). Merced County: near Le Grand, *Hoover 731* (UC); 2.9 miles southwest of Merced, *Hoover 812* (UC). Madera County: Raymond, *Eastwood 12578* (CAS). Monterey County: Del Monte, *Elmer 3550* (CAS, POM, UC); Bardino, *Elmer 4601* (CAS, POM, UC). San Luis Obispo County: Nipomo Mesa, *Eastwood & Howell 3886A* (CAS); Pismo Creek, 3 miles from Pismo, *Munz 9259* (POM, UC). Kern County: Maricopa Grade, *Eastwood & Howell 4050* (CAS); between Lost Hills and Semitropic, *Hoover 1805* (UC). Santa Barbara County: 5 miles west of Buellton, *Munz 10305* (POM, UC). Ventura County: Mt. Pinos, *Munz 7038* (POM). Los Angeles County: Pasadena, *Grant 803* (CAS, POM, UC); San Dimas Canyon, *Clokey & Anderson 5855* (UC); Claremont, *Baker 4759* (CAS, POM); 2½ miles south southeast of Neenach, *Gifford 206* (VTM); San Gabriel Canyon, *Eastwood 8968* (CAS); 4 miles west of Vincent, *Dressler 710* (D). San Bernardino County: San Antonio

Canyon, San Gabriel Mountains, *Ingram 105* (LAS); 8 miles east of Victorville, *Jaeger* in 1932 (POM); Waterman Canyon, San Bernardino Mountains, *Parish 11412* (UC). Riverside County: 7 miles east of Hemet, *Dressler 816* (D); 2 miles south of Lake Elsinore, *Peirson 2942* (POM, UC); Hemet Valley, San Jacinto Mountains, *Munz & Johnston 5535* (POM). Orange County: Capistrano, *Abrams 3263* (POM). San Diego County: 24 miles northwest of Carrizo, *Dressler 540* (D); mesas, East San Diego, *Ingram 103* (IN, LAS); San Felipe, *T. S. Brandegee* in 1894 (UC); San Diego, *Brandegee 3382* (POM, UC); Escondido, *Meyer 113* (UC). Baja California. Near San Antonio del Mar, *Wiggins 4540* (POM).

The color of the anthers in *M. maritima* varies from blue to blue-green, green and even purple. This species has a very diverse habit. Over most of its range the plants are typically small, but southward in Los Angeles and San Bernardino counties they become considerably larger. In most floras, the smaller phase has been known as *M. maritima,* the larger as *M. serotina.* Most keys separate them by stating that *M. serotina* differs from *M. maritima* in having "pit-like glands" present on its inner perianth-segments, and anthers that measure not over 0.75 mm. I have not been able to locate glands on any of the plants. The only difference I can find is difference in size. Both phases may have as many as two or three scapes per plant, but the southern phase is much larger, has few leaves and more flowers. I find no way of distinguishing these plants as separate species, nor any basis for designating the southern phase as a variety of *M. maritima. Muilla tenuis,* another phase found in Madera and San Diego counties differs from the typical in its slender habit.

Doubtful Species

Bloomeria gracilis Borzi, Boll. Ort. Palermo 1:19. 1897.

There is no statement as to the type locality for this plant. Being later, it cannot replace any of the specific names here maintained. From the description given by Borzi, it appears that it is a small plant of *B. crocea* var. *crocea.*

Excluded Species

Brodiaea Purpusii (T. S. Brandegee) comb. nov.

Muilla Purpusii T. S. Brandegee, Univ. Calif. Publ. Bot. 4:177. 1911. Type: Sierra de la Paila, Coahuila, Mexico, *Purpus 4959* (UC 148555!; isotypes, GH!, US!). *Bloomeria Purpusii* Macbride, Contr. Gray Herb. ser. 2, 56:8. 1918.

This taxon cannot be a *Muilla* as it has jointed pedicels. It cannot be a *Bloomeria* as it has its perianth-segments joined in a short tube. The nonstipitate ovary is similar to that found in *Brodiaea.* On these bases, I am placing this entity in the genus *Brodiaea.*

Distribution. Known only from the type collection.

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VARIATION IN SEEDLINGS OF CUPRESSUS ABRAMSIANA WOLF

CALVIN MCMILLAN

At the time of publication of the data concerning a third locality for *Cupressus Abramsiana* Wolf, comparative germination studies were being conducted on seeds collected in the three naturally occurring populations of this species (McMillan, Madroño 11:188–194. 1952). The rate of germination and the seedling characteristics had been ascertained for other members of the species-complex to which *C. Abramsiana* is closely related, and it seemed unlikely that any significant variations would be discernible in *C. Abramsiana.* In an earlier study, it was noted that seeds of *C. Abramsiana* from the Bonny Doon population (southernmost of the three populations in the Santa Cruz Mountains) showed a similarity to those of *C. Goveniana* Gord. in rate of germination and in seedling characteristics, while seeds from the Eagle Rock population (seven miles to the north) yielded few seedlings. Little significance was attached to this small yield at that time, however, as it was assumed to have been caused by faulty procedure. No duplications of the planting had been made.

In the present studies for the purpose of comparing germination behavior, one hundred seeds of each population of *C. Abramsiana* (this time including the northernmost population on Butano Ridge in San Mateo County, about eight miles north of Eagle Rock) were planted in each of two different soils as part of a soil-tolerance study. All seeds of *C. Abramsiana* used in the present studies were collected on September 1, 1951 as a random sampling from representative portions of each of the three populations, and they were planted on September 29, 1951.

The usual time required for germination in *Cupressus* is two weeks to one month. By October 15, 1951, no seeds of the Eagle Rock population had germinated, although 23 seedlings representing the Butano Ridge population and 13 of the Bonny Doon population had appeared. Those from Butano Ridge were first to germinate. On January 11, 1952, nearly three and one-half months following planting, a final count was made and the seedlings were compared as to cotyledon number (Table 1).

A striking differential of germination of seeds from the three populations of *C. Abramsiana* is shown in the present studies, although the rate of germination on two soils (a serpentine soil and a sandy soil) was approximately equal in the case of each population. Seeds from the Butano Ridge population had the highest germination rate (92.5 per cent); those from Eagle Rock had considerably the lowest (12.5 per cent); those from Bonny Doon were intermediate (56.5 per cent).

TABLE 1. DISTRIBUTION OF NUMBER OF COTYLEDONS

Species, Strain and Seed Lot Designation	Number of Seedlings				Total
	Number of Cotyledons				
	Two	Three	Four	Five	
Cupressus Abramsiana					
Butano Ridge (123), San Mateo County	0	15	125	45	185*
Eagle Rock (125), Santa Cruz County	0	0	19	6	25*
Bonny Doon (127), Santa Cruz County	0	56	56	1	113*
Cupressus Sargentii					
Mt. Tamalpais (39), Marin County	0	78	84	10	172
Cupressus Goveniana					
Huckleberry Hill (29), Monterey County	0	78	28	0	106
Cupressus pygmaea					
Mendocino City (1), Mendocino County	18	138	8	0	164
Anchor Bay (17), Mendocino County	7	108	14	0	129
Total	25	473	334	62	894

*Seedlings of *Cupressus Abramsiana* resulted from germination of two hundred seeds which were planted for each population. Seedlings of other species were the total available at time of study.

Thus these later tests upheld the difference in germination rate that had been noted in the preliminary study. The cause of this low germination in the Eagle Rock population is not known, but in this regard it is interesting to note that *C. Sargentii* Jeps. and *C. Goveniana,* which have been hypothesized as possibly having hybridized in the past to produce *C. Abramsiana,* differ in their rate of germination. Owing to a dormancy factor, *C. Sargentii* has a very low rate of germination, usually 2–5 per cent, and the germination rate of *C. Goveniana* is usually 50–60 per cent.

The variation in number of cotyledons among the three populations of *C. Abramsiana* is perhaps significant as an indication that juvenile characteristics sometimes can be utilized in *Cupressus* in addition to characteristics which distinguish the mature trees. The high incidence of seedlings with four and five cotyledons in both the Eagle Rock and Butano Ridge material might be used to substantiate the similarity of mature trees from these two populations. The rare occurrence of seed-

lings with five cotyledons and the occurrence in equal numbers of seedlings with three and four cotyledons in the Bonny Doon material conceivably might be cited as an additional character which distinguishes trees at Bonny Doon from those of the Eagle Rock and the Butano Ridge populations.

The inclusion, by some, of the populations of *C. Abramsiana* in *C. Sargentii* could be partially substantiated by the common occurrence of seedlings with five cotyledons. However, a postulated origin of *C. Abramsiana* by hybridization of *C. Sargentii* and *C. Goveniana* also finds confirmation in cotyledon number in addition to the variation in cone size, seed size, seed color and glaucousness and foliage color known to occur in the three taxa. In regard to cotyledon number it is of interest to note that two spatially isolated populations of *C. pygmaea* (Lemm.) Sarg., differing among other things in their habit of growth and seed color, are similar in range of cotyledon number (Table 1). *Cupressus pygmaea* yields frequent seedlings with two cotyledons, differing in this respect from *C. Goveniana,* a species to which it is very closely related.

The characteristic bluish gray-green color of the seedlings of *C. Sargentii* is due to a heavy glaucousness which can easily be wiped off the juvenile leaves. Although the seedlings of *C. Abramsiana* are grayish-green in color, the presence of glaucousness is less evident and more variable than in *C. Sargentii.* Of the three populations, the seedlings representing the Butano Ridge area are characteristically the most glaucous, being uniformly so, those from Bonny Doon are least glaucous, and those from Eagle Rock are extremely variable in respect to glaucousness, some being not glaucous. In contrast, seedlings of *C. Goveniana* are not glaucous, being distinctly bright green.

A conclusion which is reached from the foregoing data is that seedling characteristics and rate of germination do characterize the three populations of *C. Abramsiana* as a variable assemblage, which as now understood, could conceivably represent the results of hybridization. In no other Californian species of *Cupressus* does the known range of variability over such a limited area equal that found in the case of *C. Abramsiana.*

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DOCUMENTED CHROMOSOME NUMBERS OF PLANTS
(See Madroño 9:257-258. 1948.)

Species	Number	Counted by	Collection[1]	Locality
MALVACEAE				
Abutilon megapotamicum St. Hil. & Naud.	2n=16	E. McClintock, Calif. Acad. Sci. San Francisco.	*McClintock* 6 May 1949 CAS 360270	Cultivated at La Rochette Nursery, San Francisco, California
Corynabutilon vitifolium (Cav.) Kearney	2n=16	E. McClintock, Calif. Acad. Sci. San Francisco.	*McClintock* 4 May 1950 CAS 350398	Cultivated at La Rochette Nursery, San Francisco, California
LENNOACEAE				
Pholisma **paniculatum* Templeton	n=18	S. Carlquist, Univ. Calif. Berkeley	*Carlquist* *259* UC	Oceano, San Luis Obispo Co., California
SOLANACEAE				
Solanum carolinense L.	n=12	C. B. Heiser Jr. Ind. Univ. Bloomington	*Heiser* *3000* IND	Monroe Co., Indiana
SCROPHULARIACEAE				
Mimulus **mohavensis* Lem.	n=7	S. Carlquist, Univ. Calif. Berkeley	*Carlquist* *300* UC-J	Barstow, San Bernardino Co., California
PLANTAGINACEAE				
Plantago Rugellii Dcne.	n=4II4IV to 8II2IV	C. B. Heiser Jr. Ind. Univ. Bloomington	*Heiser* *3004* IND	Monroe Co., Indiana

*Prepared slide available.

[1]Symbols used for herbaria are those listed by Lanjouw and Stafleu, Index Herbariorum, part 1, 1952.

NOTES AND NEWS

A GIANT BRACKET FUNGUS FROM SOUTHEASTERN ALASKA. The mountains of Kuiu Island off southeastern Alaska are largely covered with dense virgin forests of Sitka spruce and western hemlock. As most of the trees in this forest have nearly reached maturity, there is a great deal of dead timber on which the bracket fungus, *Fomes applanatus* (Pers.) Wallr., appears ubiquitous.

During my four seasons at Washington Bay, Kuiu Island, working in the herring reduction plant of Storfold and Grondahl Packing Company, I have, as an ardent botanical collector, continued to scour the area for plants. On July 8, 1951, while Hugo L. Holbach and I were searching for lichens and bryo-

phytes in the dense virgin forest of the mountain rising behind Washington Bay, we suddenly came upon a bracket fungus of great size and of peculiar shape. It was growing on a dead hemlock tree and was near enough to the ground so that we were able to twist it off with our hands. The following Sunday, July 15, with four enthusiastic assistants helping carry the bracket on a stretcher improvised from hemlock poles, we were able to bring it into headquarters where photographs and measurements were made.

Length	3 feet 7.5 inches
Circumference	10 feet 2.5 inches
Width	2 feet 5.5 inches
Height	2 feet 7.5 inches
Live weight	115 pounds

This species is noted for its large sporophores. Bessey (Morphology and Taxonomy of Fungi, 1950) reports one up to thirty inches in diameter, a much smaller bracket than the one described herein. WALTER J. EYERDAM, Seattle, Washington.

BECKMANNIA SYZIGACHNE (STEUD.) FERNALD. NEW RECORD FOR ARIZONA. In 1951, three clumps of *Beckmannia syzigachne* (Steud.) Fernald (American sloughgrass) were found above the *Glyceria* zone at an elevation of 8,400 feet, near the edge of a man-made lake (Greenland Lake), Walhalla Plateau, on the North Rim of the Grand Canyon of the Colorado River in Coconino County, Arizona. Since these plants appeared to constitute a new record for the state, the strongest clump was left, and seed was scattered in the immediate vicinity. From the remaining clumps, specimens were prepared and distributed to the following herbaria: California Academy of Sciences; Grand Canyon National Park; United States National Herbarium; and the University of Arizona. The limestone rock that caps the various plateaus on the North Rim contains many springs and small sinks with ponds of fresh water that appear to offer suitable habitats for this species, but no more plants could be found. JOHN MERKLE, Agricultural and Mechanical College of Texas, College Station, Texas.